Integrating Deep Learning Models and Depth Cameras to Achieve Digital Transformation: A Case Study in Shoe Company

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Abstract. In today's fiercely competitive industrial environment, digital transformation and smart manufacturing have become important strategies for enhancing competitiveness. Digital transformation utilizes advanced technology and data analysis to make manufacturing processes more intelligent and automated, improve product quality, reduce production costs and time, and increase production efficiency. Smart manufacturing further applies machine learning, deep learning, and artificial intelligence to make the production process even more intelligent and automated. However, existing object detection models such as YOLO can only provide rectangular bounding boxes and cannot determine the actual rotation angle and inclination of objects, and lack discourse on hardware integration. Therefore, this study proposes a deep learning-based method framework that combines Yolov5 and Mask R-CNN to detect objects in real-time and calculate the object's center point coordinates, reference point coordinates for rotation direction, and inclination angle. This is integrated with a depth camera to obtain the distance between the robotic arm and the object, providing all the information required for the robotic arm to grasp the object. In simulated scenarios of stacking shoe insoles, the model proposed in this study achieved an accuracy of 97%. This technology can be applied in the factory production process, allowing robotic arms to accurately grasp objects from cluttered piles at the correct coordinates and angles, and perform sorting and assembly tasks. It can also help companies reduce costs and errors caused by human intervention, thereby enhancing their competitiveness.

Keywords. Robotic arm, Yolov5, Mask R-CNN, stacked objects, depth camera

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